

Overview of the Energy Efficiency and Renewable Energy Program

Presentation to Southeast Regional Office Meeting

Presented by:

**Marilyn Brown, Director
Energy Efficiency and Renewable Energy Program**

February 2, 2005

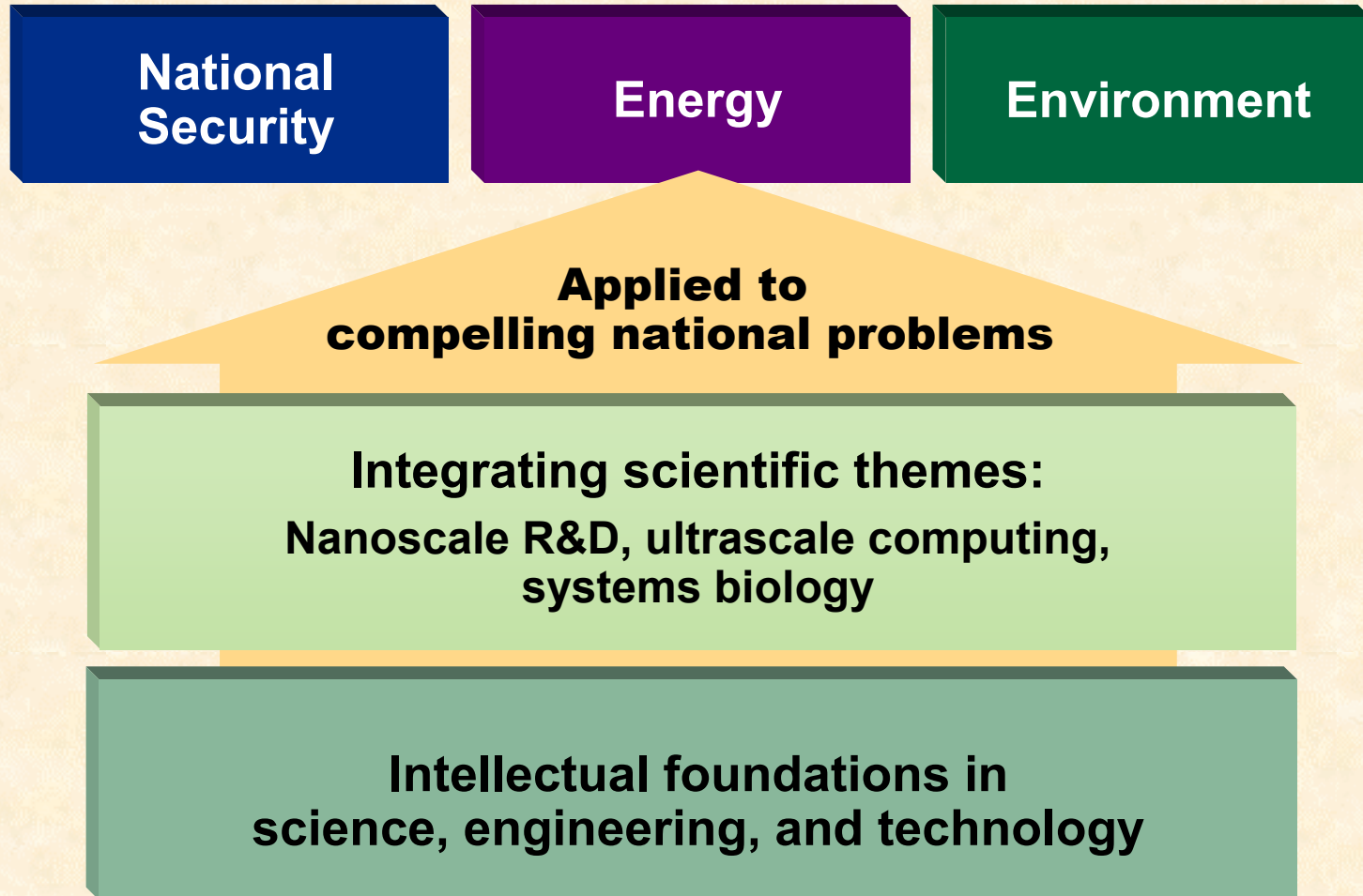
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ORNL is DOE's largest multipurpose science laboratory



- \$1.04 billion budget
- 4,000 employees
- 3,000 research guests annually
- Nation's largest unclassified scientific computing facility
- Nation's largest science facility: the \$1.4 billion Spallation Neutron Source
- Nation's largest concentration of open source materials research
- Nation's largest energy laboratory
- \$300 million modernization in progress

Oak Ridge National Laboratory's research framework



We are developing and deploying world-class tools for nanoscale R&D

Spallation Neutron Source

- High-intensity neutrons for materials research at the nanoscale
- 1.4 MW of beam power on target
- 16 instruments



High Flux Isotope Reactor

- The nation's leading research reactor
- World-class instruments for neutron scattering



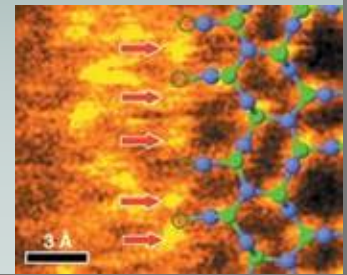
Center for Nanophase Materials Sciences

- Construction on schedule for 2006
- User program launched with 42 projects



Ultrahigh-resolution microscopy

- Advanced Microscopy Laboratory
- Aberration-corrected electron microscope
- World-record resolution: 0.6 Å



The Center for Nanophase Materials Sciences will lead us into new areas

The promise of nanoscience

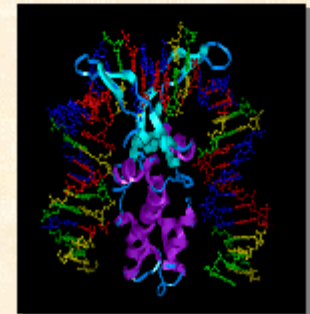
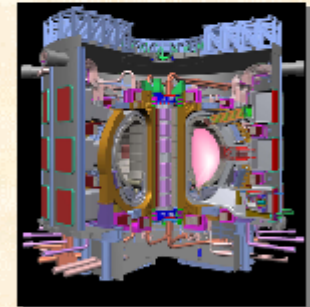
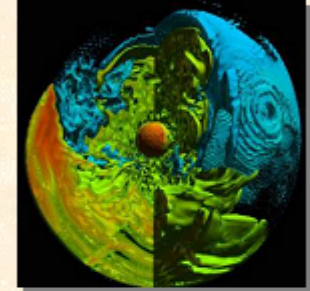
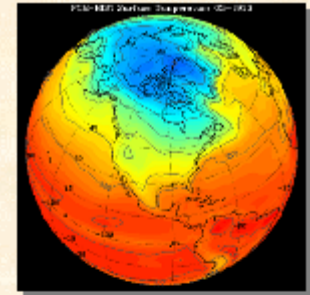
- New materials 10 times stronger than current materials
- New catalysts for a cleaner, more efficient chemical industry
- Improved fuel cells, batteries, and photovoltaics
- More powerful computers and information storage devices
- Fast chemical analyses using minute quantities of materials



OAK RIDGE NATIONAL LABORATORY
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We are at the forefront in computing and simulation

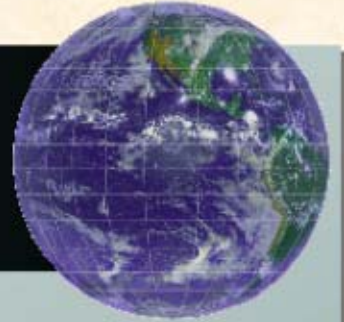
- Leading the partnership to develop the National Leadership Computing Facility
 - Leadership-class scientific computing capability
 - 100 teraflops by 2006; 250 teraflops by 2007
- Attacking key computational challenges
 - Climate change
 - Nuclear astrophysics
 - Fusion
 - Materials sciences
 - Biology
- Providing access to our computational resources through high-speed networking



We are building momentum in systems biology




Challenge: Integrate biology and ecology based on the foundation of understanding molecular-level interactions

- Identify the composition and function of “molecular machines”
- Use biological processes to
 - Produce clean energy
 - Sequester carbon
 - Help clean up the environment
- Understand how living organisms react to their environments
- Determine the genetic basis for complex traits



Oak Ridge National Laboratory

Our Energy R&D Signature:
Integration of science, technology, and thought leadership

Generation	Distribution	Consumption
<p>Fossil Fission Renewables Fusion</p> 	<p>Transmission technology Hydrogen Distributed Energy</p> 	<p>Buildings Industry Transportation</p> 
<p>Supporting DOE's strategic goals for energy security and independence</p>		

ORNL's EERE Program is sponsor-oriented

Mission

Collaborative research, development, and analysis of energy-efficient and renewable energy technologies to strengthen America's energy security, environmental quality, and economic vitality

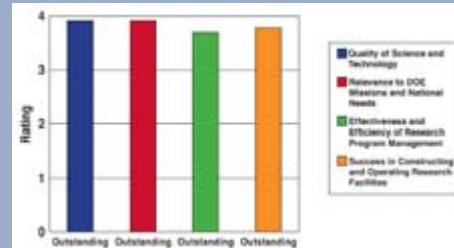
Sponsor, Customers, and Approach

- DOE is the sponsor
- Industry and the public are our customers
- States and universities are key partners

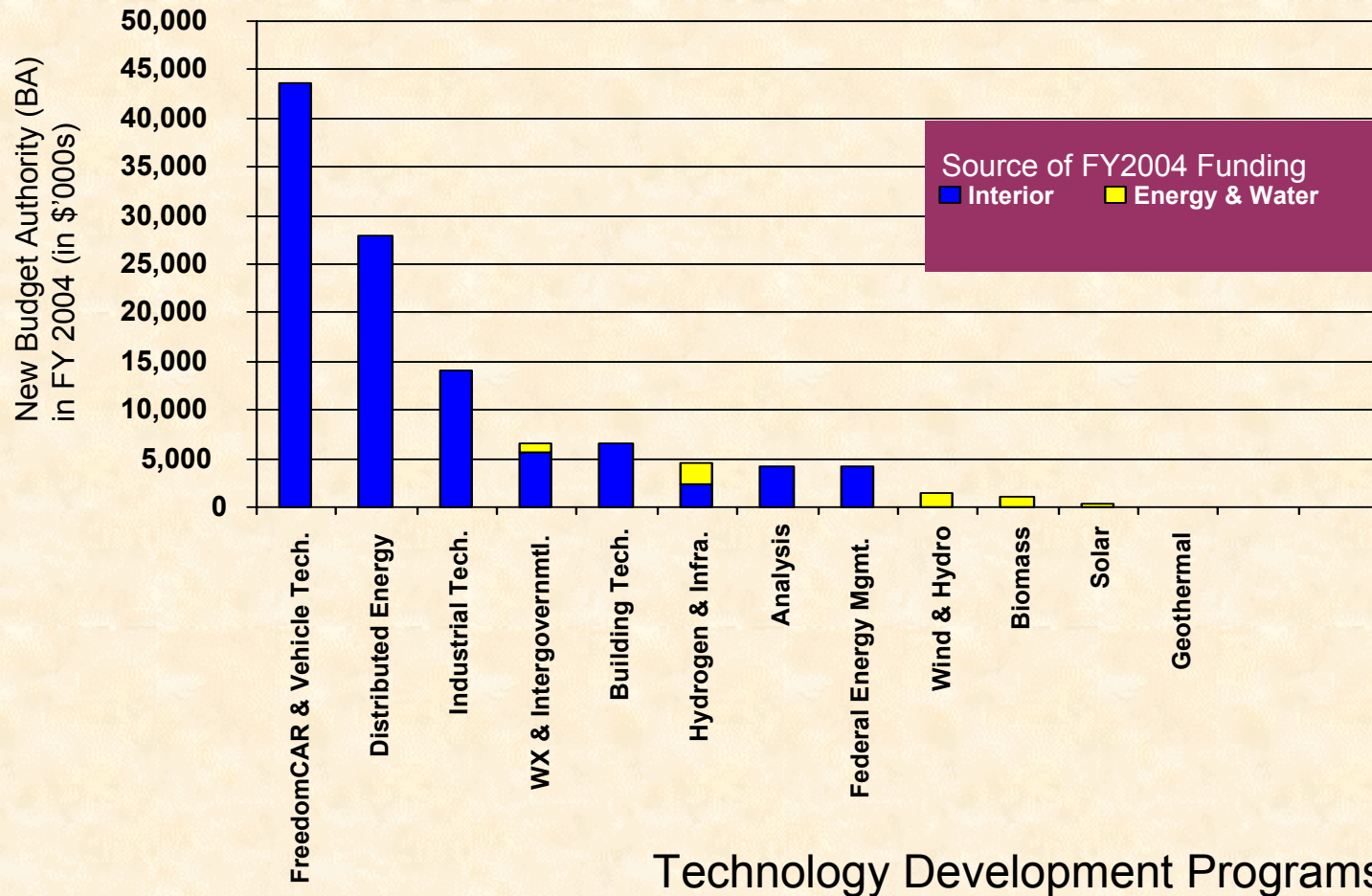


Scope

- All energy use sectors
- FY2002: \$121M
- FY2003: \$113M
- FY2004: \$127M (\$115M + \$12M)



ORNL has the largest portfolio of energy efficiency R&D in the DOE Lab system



ORNL's EERE Management Team



David Hill

- Associate Lab Director, Energy and Engineering Sciences



Marilyn Brown

- Energy Efficiency & Renewable Energy Director



Dave Stinton

- Distributed Energy



Ed Grostick

- FreedomCAR & Vehicle Technologies



Pete Angelini

- Industrial Technologies



Patrick Hughes

- Building Technologies



Tim Armstrong

- Hydrogen, Fuel Cells & Infrastructure



Marilyn Brown

- Weatherization & Intergovernmental



Patrick Hughes

- Federal Energy Management Program



Robin Graham

- Biomass



Mike Sale

- Wind & Hydropower



Melissa Lapsa

- Solar



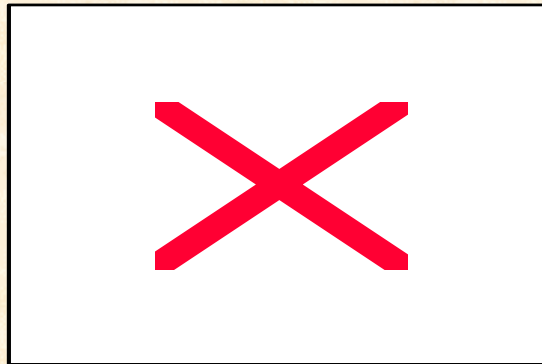
Russ Lee

- Planning & Analysis

Six EERE National User Centers offer unique Equipment and Capabilities



High Temperature Materials Laboratory (HTML)



Distributed Generation and Cooling, Heating and Power Integration Laboratory



Metals Processing Laboratory User Center (MPLUS)



Bioprocessing R&D Center (BRDC)



Buildings Technology Center (BTC)

National Transportation Research Center (NTRC)

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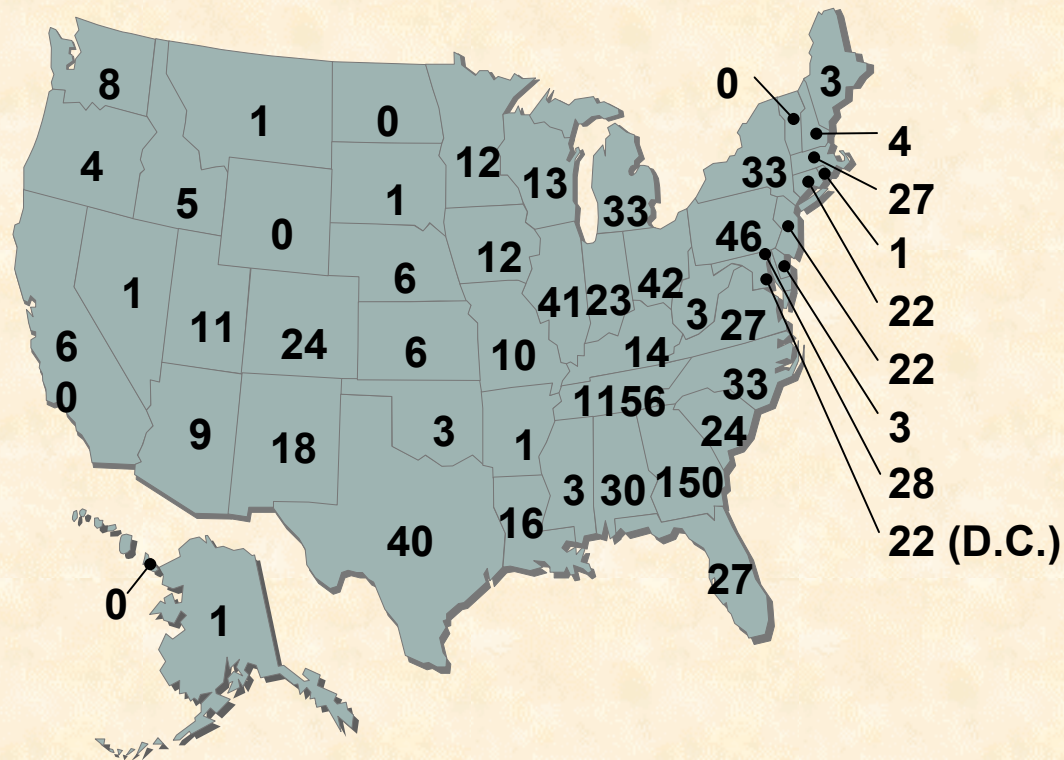


ORNL's EERE User Facilities are a catalyst for scientific discovery and partnerships

FY 2003 User Statistics for ORNL's EERE User Facilities:

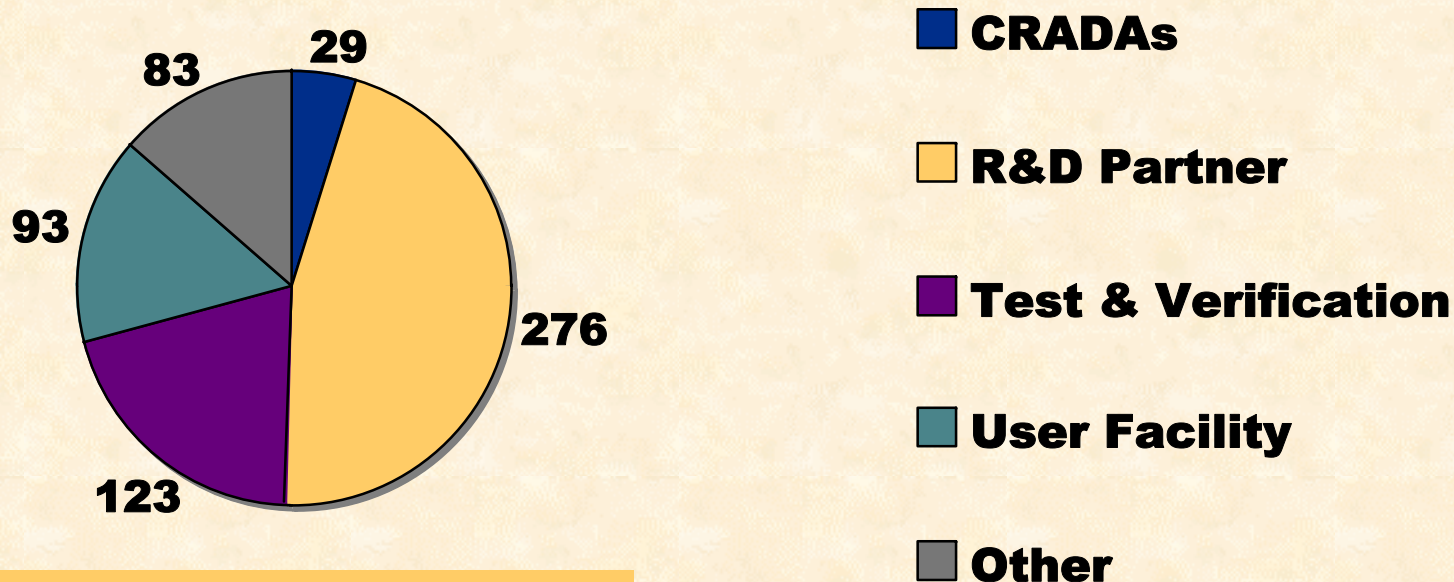
- Organizations: 402
- Experimenters: 3,630
- User Days: 7,629

In addition, ORNL hosts 10,000+ visitors and 3,000 guest researchers each year



ORNL's EERE Program has strong interactions with industry

- Industry partnerships increase the effectiveness of EERE's R&D and accelerate technology adoption.



FreedomCAR & Vehicle Technologies

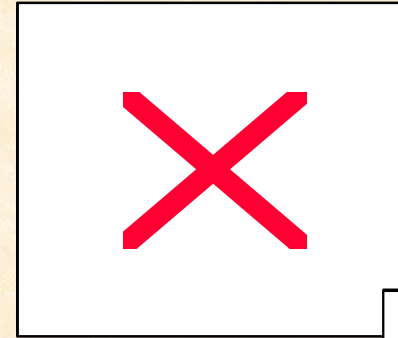
Mission: Develop more energy-efficient and environmentally friendly highway transportation technologies that enable America to use less petroleum.

- **Major Activities and Facilities:**

- Fuels, Engines and Emissions
- Advanced Power Electronics & Electric Machinery
- Lightweight Structural & Propulsion System Materials
- High Temperature Materials Laboratory
- National Transportation Research Center

- **Recent Achievements:**

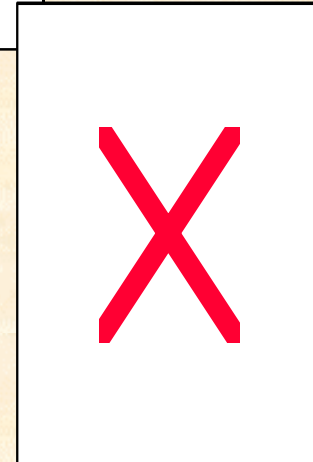
- Advanced low-temperature combustion regimes that offer low NOx & particulate emissions, high fuel efficiency
- Low cost, high efficiency converters, inverters, and motors for electric hybrid and fuel cell vehicles
- Carbon fiber cost reduction using novel processing methods and renewable feedstocks
- R&D 100 award winners:
 - strong, low-creep CF8C stainless steel
 - metal compression forming for aluminum
 - high thermal conductivity graphite foam
 - gelcasting of ceramics



Top: Dual-mode inverter controller

Center: Vehicle systems research

Bottom: CF8C-Plus: Cast stainless steel for high-temperature performance



Distributed Energy

Mission: Improve the energy and environmental performance of the distributed technologies and increase the level of technology integration among on-site energy generation alternatives so the nation can achieve a more flexible, smarter energy system.

- **Major Activities and Facilities:**

- Technology Base
 - Turbines & Microturbines
 - Reciprocating engines
 - Materials
 - Thermally activated equipment
- Integrated Energy Systems
 - Systems integration modeling
 - Optimized, replicable CHP systems

- **Recent Achievements:**

- Microturbine Test Facility: systems integration modeling and testing
- Supported the development of UTC PureComfort 240 & other systems
- Lean No_x trap technology demonstrated
- Control techniques to reduce combustion variability in reciprocating engines



UTC Power PureComfort 240
(microturbine/chiller system)

ORNL IES Accomplishments

Honeywell Project

- Installed prototype system with 5-MW Solar turbine, 1,000-ton Broad chiller, and HRSG at Fort Bragg, NC
- Development of supervisory control systems with on-line optimization using real-time pricing
- Provision of reliable power to strategic command center & hospital with savings of \$1.8 MM



Honeywell



Burns & McDonnell Project

- Clean energy in NO_x non-attainment zone
- Installation of 5MW turbine & waste heat-fired 2,500-ton absorption chiller
- Ribbon Cutting Ceremony Held in June 2004



United Technologies & Capstone Project

- PureComfort 240 installed: New York August 2004
- Modular system that combines a microturbine and 100 ton Carrier absorption chiller
- Saves up to 50% by powering air conditioning with waste heat instead of electric power



Industrial Technologies

Mission: Improve the energy intensity of the U.S. industrial sector through a coordinated program of research and development, validation, and dissemination of energy efficiency technologies and operating practices.

- **Major Activities and Facilities:**

- Industries of the Future
- Industrial Materials for the Future
- Best Practices (pumps, compressed air, steam, process heating, and fans)
- Sensors and Automation
- Metals Processing Laboratory Users Facility

- **Recent Achievements:**

- Microwaves modify structure of wood
 - reduces processing chemicals ~40%
 - reduces energy use by ~50%
- Nickel aluminides
- Unique tools for identifying energy savings opportunities
http://www.ornl.gov/engineering_science_technology/industrial%20energy.htm
- Wireless sensing and control technologies

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MPLUS – Metals Processing Laboratory Users facility – has generated significant industrial and university interactions


UT-BATTELLE

Building Technologies

Mission: Improve the energy efficiency of our nation's buildings through innovative new technologies and better building practices.

- **Major Activities and Facilities:**

- Space Conditioning & Refrigeration
- Appliances
- Building Envelopes
- Residential & Commercial Building Integration
- Buildings Technology Center

- **Recent Achievements:**

- 1 kWh/day refrigerator
- Zero energy Habitat Houses
- Frostless heat pump
- Heat pump water heating dehumidifier
- Energy rating tools (walls, roofs, ...)



Rotatable guarded hot box in the Buildings Technology Center. The hot box has been used to test the thermal performance of more than 200 wall systems.

Weatherization and Intergovernmental

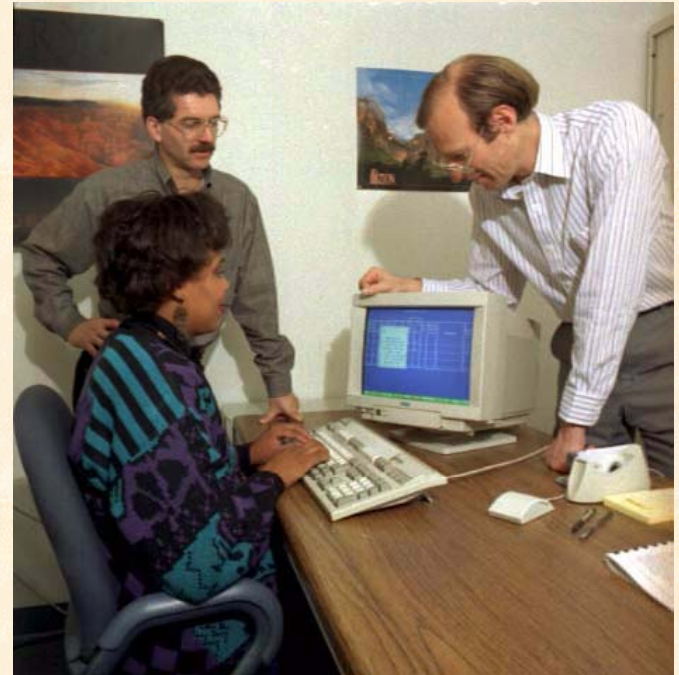
Mission: Deliver targeted solutions designed to increase energy efficiency in buildings, transportation, industry, and communities by providing information and technical and financial resources.

- **Major Activities and Facilities:**

- Weatherization (Wx)
- State Energy Program (SEP)
- International Activities
- Rebuild America
- Clean Cities
- Inventions and Innovations

- **Recent Achievements**

- Manufactured Housing Tool added to National Energy Audit (NEAT)
- SEP and Wx evaluation metrics
- 2004 fueleconomy.gov web site
- Web-based GIS framework for a Geographically Integrated Renewable Energy and Energy Efficiency Technology Deployment Decision Support Screening Tool (GREEN)



Using the National Energy Audit

Hydrogen, Fuel Cells, and Infrastructure

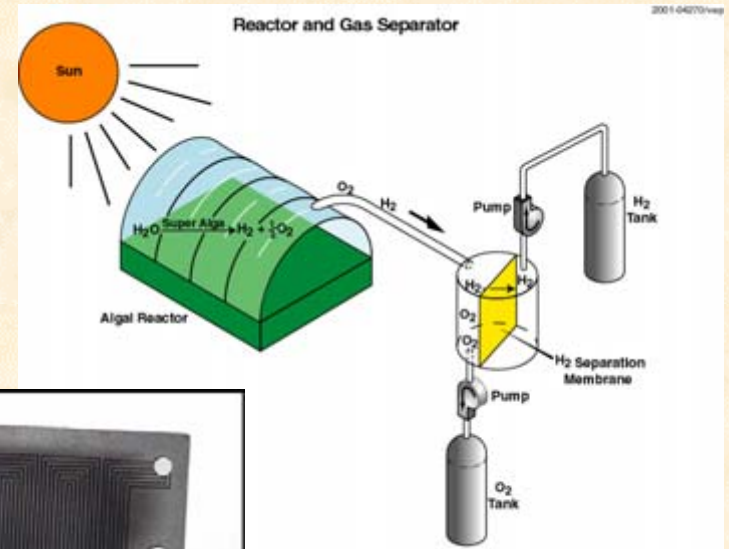
Mission: Research, develop, and validate fuel cells and hydrogen production, delivery, and storage technologies for transportation and stationary applications.

- **Major Programs and Facilities:**

- Modeling and Simulation
- Alloy Design/Materials Corrosion
 - Pipeline and weld materials
- H₂ Separation
 - Microporous membranes
 - Ion transport membranes
- Gas Cleanup
 - Carbon fiber composite sieves
 - Desulfurization catalysts
- Renewable Production of H₂
 - Algal production of H₂
 - Enzymatic production of H₂ from glucose

- **Recent Achievements:**

- Carbon composite bipolar plate developed and licensed to Porvair Fuel Cell Technologies
- Membrane characterization
- Desulfurization of hydrogen



Solar

Mission: Improve America's security, environmental quality, and economic prosperity through public-private partnerships that bring reliable and affordable solar energy technologies to the marketplace.

Major Activities:

- CRADAs with industries
- Developing pre-commercial hybrid lighting components
- Implementing nationwide field trial demonstration

Recent Achievements:

- Demonstration of first-generation hybrid solar lighting at the National Transportation Research Center
- Designed second generation system adapted to utilize centralized bundled optical fibers



ORNL/EERE Research Staff: World-Class and Award-Winning



Edgar Lara-Curzio received the 2003 Richard M. Fulrath Award from ACerS



C.T. Liu elected to National Academy of Engineering, 2004



R&D 100 Winners

- CF8C-Plus Stainless Steel
- Graphite foam with high thermal conductivity
- Heat pump water heater
- Advanced Heating System for high-performance aluminum forgings



Since 1963 ORNL staff have won 119 R&D 100 Awards, 2nd only to GE

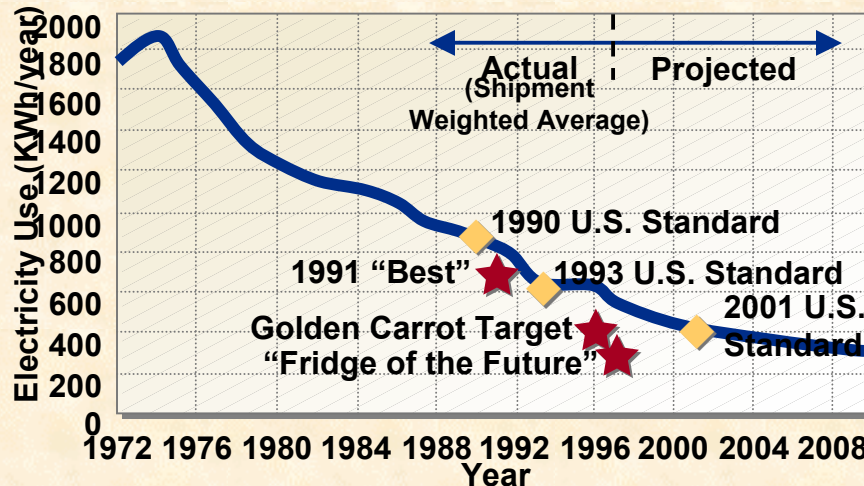
ORNL/EERE has won 46 R&D 100 Awards

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ORNL's EERE Program is results-driven

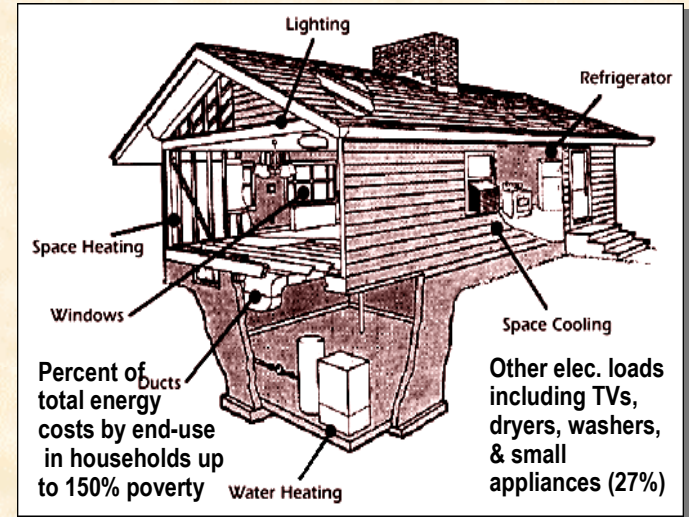
- Working with our partners, ORNL has produced numerous advances with widespread impacts



High-efficiency refrigerator: Research and standards have cut refrigerator energy use by 2/3, saving \$9 billion.



High-performance carbon graphite bipolar plate:
Reduces fuel cell cost by about \$5500, weight by 40 kg.



National Energy Audit: distributed to 750 agencies in 34 states, saving ~\$70 million/year.



Nickel aluminide furnace fixtures and rolls: stronger and more corrosion-resistant, eliminating furnace shutdowns and reducing energy consumption by 35%.

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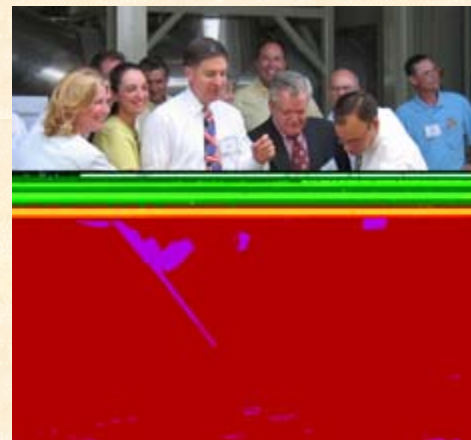
UT-BATTELLE

ORNL's EERE Program is results-driven (cont.)

- Working with our partners, ORNL has produced numerous advances with widespread impacts



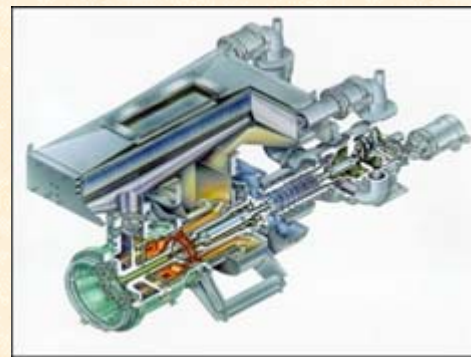
Lightweight composite materials: Now in several production vehicles.



Burns & McDonnell system integrates a 5-MW combustion with a 2,500-ton absorption chiller.



World's first use of HTS cable in industry: Powers two manufacturing plants.



Improved materials for industrial gas turbines: in the market today.

**We are transforming ORNL
into a modern research campus
for the 21st century**

